

Applicant : Shuichi Kikuchi et al.
Serial No. : 09/444,819
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Attorney's Docket No.: 10417-006001 / S21-
118827M/HW

REMARKS

This Reply is responsive to the Office Action mailed 12/11/2002, which was a final rejection of all then-pending claims (Nos. 1-4, 8-10, 17 and 19-32) based on the previously cited, principal prior art reference (Kwon et al).

Independent claims 1, 2, 8 and 9 have been amended, incorporating substantially the limitations of claims 20 and 21, which have been cancelled, to expedite allowance without an appeal. Claims 33 and 34 have been added to expedite allowance without an appeal. Claims 33 and 34 are similar to claims 22 and 23, but depend from claims 3 and 4, respectively, and relate to the use of different dopants in claims 3 and 4.

Claims 1-4, 8-10, 17, 19 and 22-34 are under consideration.

Amendments to Claims 1, 2, 8 & 9

Without waiver of any of the other grounds for patentability that they have previously asserted and assert below, Applicants urge that the grounds for rejection of claims 1, 2, 8, 9 and 21-22 should be withdrawn and, therefore, the amended claims should be allowed. Applicants also urge that all claims be allowed because of the inclusion of the substance of former claims 20 and 21 in amended claims 1, 2, 8 and 9.

As discussed in the last response, all of the independent claims have included a limitation requiring that a drift region formed shallowly at least below at least a substantial part of the gate electrode, and having a substantially uniform depth under said gate." Applicants believe the limitations of that type fully distinguish the cited art.

As described in page 13 line 28 to page 14 to line 9, the effect of this claimed structure is that the ON-resistance can be reduced and also the current flow can be made easy.

The Office Action mailed 6/17/2003, cited Figs. 1 and 4 of Kwon against claims 1, 2, 8 and 9. (Pages 2-4 & 6) That Office Action did not point to any place in Kwon disclosing or suggesting Applicant's substantially uniform depth under the gate that is required by those claims.

Former claims 20 and 21 added the limitation "wherein the entire first part of said drift region is located below said gate electrode." The Office Action mailed 6/17/2003 stated that:

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With respect to claims 20 and 21 Kwon describes a semiconductor device in accordance with claim 1, wherein the entire first part of said drift region is located below said gate electrode. (Kwon figure 2)

Clearly, Fig. 2 of Kwon does not show that there is a shallow part of a drift region, having substantially uniform depth, that is entirely located below the gate electrode in the way previously claimed in claims 20 and 21, and now claimed in amended claims 1, 2, 8 and 9. Because Kwon does not disclose or suggest either a drift region part formed shallowly at a substantially uniform depth below at least a substantial part of the gate electrode, or the limitation added by the present amendments, these independent claims and all of the dependent claims should be allowed.

For each of the reasons stated, all pending claims should be allowed.

Claims 3-4 and 33-34

In rejecting claims 3 and 4, the Office Action stated that certain limitations were product-by-process limitations and treated them as non-limiting. (Page 5) We respectfully point out that, irrespective of the legal validity of those statements, in the case of claims 3 and 4, the limitations in question are structural limitations. The phrase "is doped with" in claim 3 (from which claim 4 depends) defines elements of the claimed device and the claimed dopants (impurities) are found within the structure of the claimed device. The presence of those dopants as claimed distinguishes the cited art. (Although irrelevant, because of the distinction just stated, for the record we also respectfully disagree with the proposition that product-by-process limitations can be treated as non-limiting. Limitations are limitations and cannot be ignored.)

The Office Action does not identify the alleged pertinence of Blanchard et al to claims 3 and 4, in spite of the fact Applicants pointed that out following the previous rejection of those claims on the same grounds. It admits (at page 6) that "Kwon does not specifically mention a second conductivity type well region." We point out that Kwon et al also does not implicitly refer to such a region.

New claims 33 and 34 are based on claims 22 and 23, but depend from claims 3 and 4, respectively. In rejecting claims 22 and 23, the Office Action stated:

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With respect to claims 22 and 23 Kwon describes a semiconductor device in accordance with claim 1, wherein the dopant concentration of said first part is higher than that of said second part (it is inherent from Kwon figure 2 that the second region is below the first region and therefore the first region has higher concentration because the implanted ions have less distance to travel).

Claims 33 and 34 differ from Kwon in that in the Kwon reference, the same kind of impurity is injected; however, in the invention of claims 33 and 34, which depend from claims 3 and 4, different impurities are injected.

The cited part of Kwon discloses a portion doped with phosphor ions having a concentration of $6.8 \times 10^{12} \text{ cm}^2$ at an energy of 150 KeV in Fig. 5B. (Col. 5, line 66 to col. 6, line 1) In fig. 5D, phosphor ions are injected with the concentration of $1 \times 10^{12} \text{ cm}^2$ at an energy of 80 KeV. (Col. 6, line 24 to 25)

In the present application, in Fig.2A, the arsenic ion is implanted by the accelerating voltage of about 160 KeV at a dose of $3 \times 10^{12} \text{ cm}^2$ for first portion and the phosphorus ion is implanted by the accelerating voltage of about 50 KeV at a dose of $4 \times 10^{12} \text{ cm}^2$ for second portion.

For the reasons stated in this section, in addition to those stated with respect to claims 1 and 2, Applicants submit that claims 3-4 and 33-34 should be allowed.

Claims 24-32

The Office Action summarized its reasons for rejecting claims 24-32, saying:

With respect to claims 24 to 32 it is noted that the specification contains no disclosure of either the critical nature of the claimed dimensions or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimension or upon another variable recited in the claim, the Applicant must show that the chosen dimensions/other variables are critical.

(Page 8) Although the Office Action went on to make more specific comments regarding these claims, nowhere did it show that the claimed combination was taught or suggested by the cited combination of prior art (Kwon plus Blanchard).

Claims 24 to 32 were added at the suggestion of the Examiner. The additional limitations of these claims are supported as follows: claim 24 supported at page 16, lines 4 and 5; claim 25

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supported at page 17, lines 8 to 10; claim 26 supported at page 18, lines 25 to 29; claim 27 supported at page 18, lines 1 to 5; claim 28 supported at page 19, lines 9 and 10; claim 29 supported at page 19, lines 9 and 10 and lines 19 and 20; claim 30 supported at page 21, lines 24 and 25; claim 31 supported at page 25, lines 9 to 13; and claim 32 supported at page 25, line 26. We submit that these claims are allowable both for the reasons stated with respect to the claims from which they depend, and because the claimed combination of each claim was not taught or suggested by the cited combination of prior art.

Further Arguments

For completeness, and to avoid any inference that arguments have been abandoned, Applicants include here the following arguments that were presented in the last response.

Kwon et al does not disclose or teach a drift region which is formed shallowly below a gate and deeply in the neighborhood of a drain. Rather, Kwon et al discloses that the region cited in the Office Action is formed adjacent a gate, using the gate as a mask.

Further, Kwon et al does not disclose the cited drift region as being under a substantial part of the gate or as having a substantially uniform depth under the gate.

The citation of Kwon et al does not satisfy the strict legal requirement for anticipation, which requires that the cited reference disclose the same invention as claimed.

For simplicity, Applicants have focused on the difference between the drift regions in Kwon et al and the present application. For example, Applicants point to the following drift regions, gates and drains depicted and described in the present application:

Figs. 1, 5 & 8 drift region 22 gate 7 drain 5

As seen in these drawings, the drift region is formed shallowly at a uniform depth under a substantial part of the gate and more deeply under the drain. See, for example, Fig. 1.

As explained with respect to Figs 2A, 3A and 3B, the region 22 is first formed at a full, uniform depth (Fig. 2A), the left part 22A of the drift region is then made shallower by implantation and diffusion of opposite type dopant into that part 22A. Then, gate 7 is formed over the shallow part. (Page 5, lines 2 -22) In terms of the device, the shallow part of diffusion layer, having a uniform depth, has been intentionally placed under the gate. The present

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application teaches that the disclosed and claimed structure is intended to produce an "improved RESURF effect." (See, e.g., page 4, line 28 – page 5, line 1; page 6, lines 16-19)

In Kwon et al, like the withdrawn reference of Bulucea et al, the regions cited by the Examiner are merely the small amount of diffusion that occurs at a non-uniform depth at the edge of any diffusion mask, in this case the gate. See Figs 1, 2, 3 and 4, described at 1/53-55, 2/10-13, 4/6-8, 4/67 – 5/3, 5/27-30. Kwon et al discloses the use of gate 24 as a mask in forming the edge of the region cited by the Office Action, so that the gate and that region are "self-aligned." (Col. 6, lines 17-30) Also, the region extending under the gate edge is described as lightly doped. See Kwon, 4/6-8, 4/61-64, 5/22-24. These facts distinguish the cited references from the Applicant's claims.

The Section 103(a) Rejections

The Office Action fails to establish a *prima facie* case of obviousness of the rejected claims, either before or after the amendments, in several respects. First, Kwon is not a pertinent reference for the reasons stated above. Further, the Office Action fails to point out any teaching or suggestion in the cited references that might lead a person of ordinary skill in the art to combine the references. (We also caution against application of the Examiner's skill, which is above the "ordinary" level: a Masters degree and several years examining experience, which provides intensive experience in the art.)

Additional distinctions of Blanchard et al are stated in Applicants' previous response and previous Appeal Brief.

For all of these reasons, none of the pending claims is obvious from the cited references.

Reconsideration and allowance of all claims is respectfully requested.

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